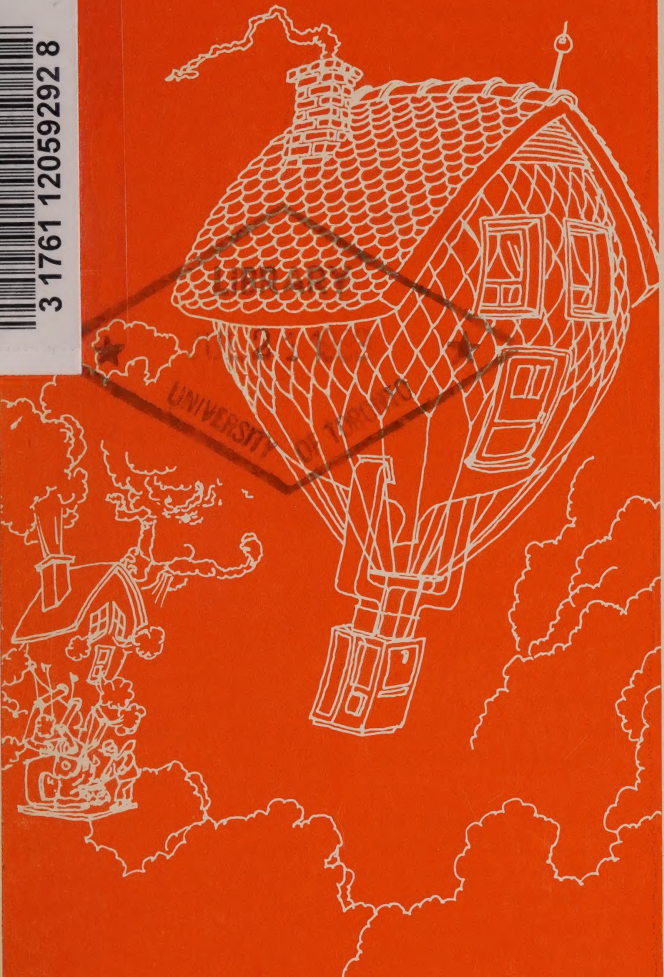
make the most of your heating system



Ontario
Ministry of
Municipal Affairs
and Housing
Hon. Claude F. Bennett
Minister

Energy
Ontario

Introduction

Both the Ontario and federal governments have established policies and programs to encourage homeowners to reduce energy consumption and dependence on imported oil. The purpose of this booklet is to review some of the ways to meet these objectives by improving your heating system and lowering your fuel bill. The booklet will help you make decisions about your home heating system in a planned and cost-effective manner.

This booklet has been prepared by Retrospectors and Renewable Energy in Canada on behalf of the Ministry of Municipal Affairs and Housing.

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Renovation and Energy Conservation Unit
Ministry of Municipal Affairs and Housing
Queen's Park, Ontario
M7A 1N3

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First Seal Your House

For both technical and economic reasons, your first priority should be to conserve energy by reducing excessive air leakage and adding insulation. These measures will reduce fuel consumption and increase your comfort — both in summer and winter. Refer to the ministry's booklet *First, Seal Your House* for more details. If you plan more extensive work on your house consult the ministry's *Conserve Energy When You Renovate* booklet. By reducing the heating requirements of the house first, you will be able to purchase a heating system properly sized for your reduced energy needs.

How To Use This Booklet

Virtually all heating systems will perform more effectively with proper maintenance, temperature control and heat distribution. These improvements may be made while you are weatherizing and insulating, and before you make major decisions about your heating system. The first section of this pamphlet describes such improvements.

The second section deals with major alterations to the heating system, from upgrading to replacement.

The final section contains suggestions about where to go for further information, advice about hiring a contractor, and an example comparing the cost implications of the various alternatives.

Seeking Advice

While you can easily perform many of the improvements discussed in this booklet, such as changing furnace filters or oiling circulating pumps, many of the activities must be performed by a qualified service mechanic. This will usually be an oil burner mechanic or a gas fitter certified by the Fuel Safety Branch of the Ontario Ministry of Consumer and Commercial Relations.

You should spend time to find the right person for the job. Your fuel supplier can recommend a reputable service company, but it always pays to shop around. Check the yellow pages for heating contractors or furnace service companies. You should choose one which is registered with the Fuel Safety Branch. You can use this booklet to discuss energy efficiency and safety features of different options and techniques with the service mechanic.

Your Heating System

Efficiency

Conventional oil and gas furnaces usually operate at a peak efficiency of between 70 and 85 per cent. However over the entire heating season furnaces are less efficient, extracting only 50 to 60 per cent of the heat in the fuel.

The conventional heating system is inefficient for various reasons. Incomplete combustion can occur when the burner is starved for air or not adjusted or tuned properly. The heat exchanger can get dirty, preventing efficient heat transfer. On some units, the pilot light burns continuously so heat can be lost up the chimney. Heat can also be lost in the distribution system, and warm basement air flows up the chimney when the furnace is not running.

You can improve efficiency by following a regular program of maintenance for both the furnace and distribution system, as discussed on pages 4 to 12. As well, major upgrades are often worthwhile with newer oil units.

Finally it might be worthwhile to replace your system entirely, especially if it is an old oil unit.

We discuss these options of simply maintaining, upgrading or replacing the system starting on page 13.

Safety

Safety considerations should be uppermost in your mind. All conventional heating systems are safe when operating properly. You should understand how the system works because changing part of the system, or even renovating your house, can affect how your heating system operates.

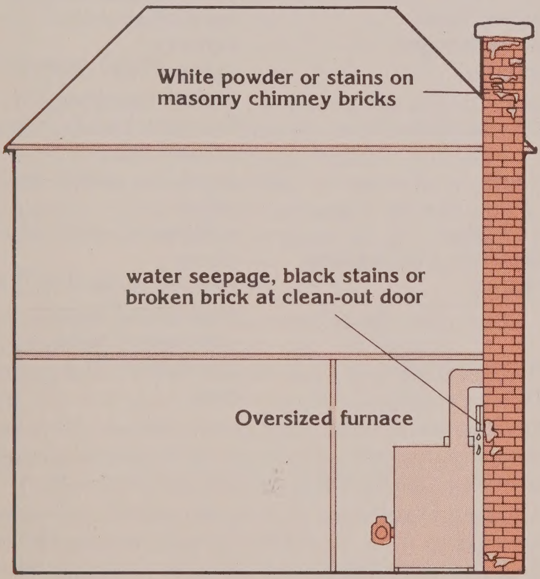
An oil or gas-fired furnace requires a constant supply of air to operate safely. Air is needed to burn the fuel and to vent the products of combustion up the chimney.

When a furnace is starved for air, it's usually because air is being rapidly expelled from the house through other routes: i.e. a roaring fireplace or stove, a power vent in the attic, a third floor window left wide open, or exhaust fans operating continuously. If your house or basement has been sealed to prevent drafts, you may have to provide some controlled ventilation. Ducts with adjustable dampers can be run from outside directly to the fireplace or furnace area. Consult the ministry's fact sheet *Fresh Air and Humidity in a Tighter House* for details.

Another safety consideration is the state of the chimney. If the gases escaping up the chimney cool too much, condensation can occur. This can corrode the brick and lead to bits of masonry build up. In extreme cases this debris can combine with ice to block the chimney. Condensation is more likely following a conversion from oil to gas, especially if the chimney is on an outside wall.

Condensation can be caused by a combination of circumstances which reduce the temperature of the flue gases or allow the chimney to overcool. For example, an oversized furnace or major energy conservation effort may mean your furnace will be off for long periods of time. Also a sealed, unheated furnace room or cracks in the chimney can cause overcooled flue gases. Symptoms include water seepage or black stains at the clean out door below the point where the flue enters the chimney. White powder stains on the outside of masonry chimneys or broken bits of brick in the chimney are also symptoms.

The solution to this condition is usually a new chimney liner approved or accepted by the Fuels Safety Branch. Liners are a requirement in almost all conversions from oil to gas. If you have already had your system converted, watch for these symptoms. If you have any questions, contact your gas utility for a chimney specialist referral.



SIGNS OF CONDENSATION

I. MAINTENANCE

All heating systems, whether oil, gas or electric, require on-going maintenance to provide safe, efficient and long-lasting performance. Electric systems are the easiest to maintain but still require regular cleaning and maintenance of the distribution system.

Oil Systems

Oil systems should be serviced every year. The checklist below is a brief guide which you can discuss with your furnace service mechanic. For a more detailed explanation, get a copy of *The Billpayer's Guide to Furnace Servicing* from the Department of Energy, Mines and Resources, Canada.

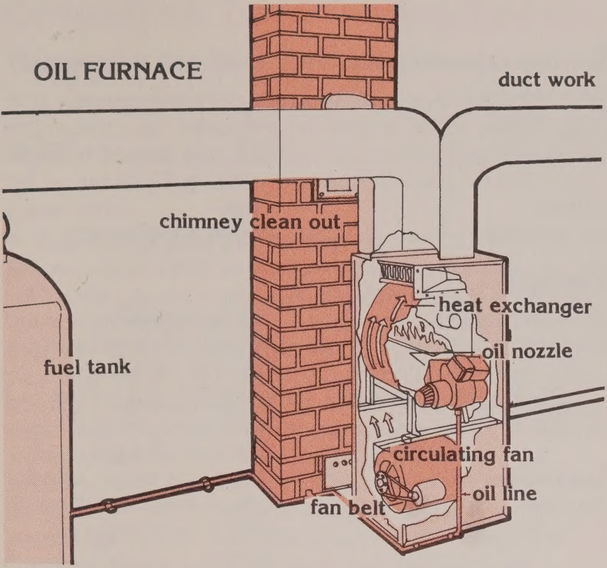
Annual Servicing

Furnace servicing involves replacing or cleaning dirty parts, lubricating the moving parts,checking the safety controls and tuning the system. *A certified oil-burner mechanic must perform the following jobs:*

exhaust breeching	— vacuum
oil filter	— inspect or replace
barometric damper	— clean and adjust
electrical connections	— inspect
stack controller	— clean and check safety timing
ignition electrodes	— inspect, clean and reset
chimney	— inspect for blockage or deterioration
chimney base	— vacuum
heat exchanger	— vacuum
oil nozzle	— replace with proper type if necessary
circulating fan	— lubricate bearings and adjust belt
fan belt	— check for cracks and wear
fan blades	— scrape or brush clean
burner fan and housing	— clean
air filters	— replace twice yearly minimum. Clean if permanent type.
safety controls	— check high limit
panels	— seal

Other components of your system should be thoroughly inspected to ensure safe operation and preventive maintenance. Some key items are:

- fuel tank filling, and vent pipes
- fuel level indicator
- furnace casing
- oil line leaks
- warm air ductwork
- exterior chimney condition



Tuning Burner

A typical tune-up of your furnace involves only adjusting the burner. An instrumented tuning is more comprehensive and the extra cost is definitely worthwhile. Such a tuning involves smoke tests (using a hand pump) and chimney draft measurements with a gauge. This thorough cleaning and tuning of your oil system (a job that may require two hours) can reduce your fuel consumption by as much as ten per cent on a poorly maintained unit.

Efficiency Tests

An efficiency test simply measures the effectiveness of your furnace in extracting the heat energy from the oil. Efficiency tests do not improve efficiency and are useful only if you wish to know how your cleaned and tuned system compares to last year's performance or to other systems on the market.

Gas Systems

Gas systems should be serviced every two years. Normally gas burns cleaner than oil. Regular servicing and proper maintenance is *important for safety* but the potential for energy saving from cleaning and tuning is not high.

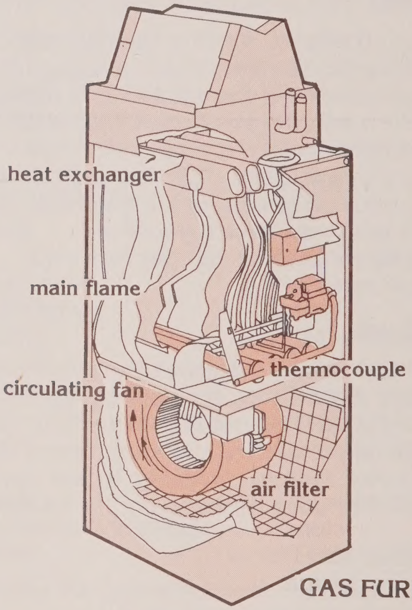
A gas furnace *must be serviced by a certified gas fitter.* Begin with a thorough inspection of the chimney breeching, draft hood, and chimney base clean-out. A checklist of additional work is presented below, and can be used in discussion with your service mechanic. For a detailed description refer to the *Billpayer's Guide to Furnace Servicing.*

Burner Operation

pilot light	— inspect and clean
main flame	— inspect
thermocouple	— test and record millivolt reading
burner	— clean
air shutters	— adjust if necessary

Furnace

limit controls	— check operation
heat exchanger	— inspect for cracks and clean if necessary
circulating fan & motor	— lubricate and adjust
air filters	— replace or clean if permanent type
fan blades	— scrape or brush clean
fan belt	— adjust if necessary and check for cracks or wear



GAS FURNACE

Boiler Systems

Space heating systems that use pipes and hot water require regular service of the burner as described above. Other items mentioned below require special attention which you can do yourself. See page 10 for further details.

- bleed air from radiators
- drain expansion tank
- inspect for leaks
- lubricate water circulation pump

Controlling Your Heating System

Thermostat Set-Back Devices

You can obtain energy savings by having the thermostat set low when no-one is home and at night when you are asleep. You can lower your fuel bill by up to 14 per cent by cutting back 5°C (9°F) at these times.

A thermostat set-back device can control the supply of heat to the house automatically. Although you can set back the thermostat manually, these automatic devices are convenient because they are easy to use, they never forget, and they permit a warm-up period when you're on your way home or before you get up in the morning. This is especially important for homes heated with hot water radiators because they can take hours to warm up and cool down. Set-back thermostats can be either a mechanical or a digital design. Some permit up to four automatic adjustments per day. Because these units will keep the house at the lowest comfortable temperature continuously and accurately they are a very cost-effective investment.

You can install set-back thermostats yourself. They are available through heating contractors and hardware stores. Ensure that your control system is the correct voltage for your thermostat by following the installation instructions. All the round thermostats and most square thermostats are 24 volt (see illustration). Both use fine 18-guage wire. A few older control systems operate on 110 volts and will burn out most set-back devices unless a small transformer is connected to the line first. *Consult a qualified technician for advice* or remove the cover on the thermostat and check the specifications.

Some gas furnaces use a millivolt thermostat which doesn't require an outside electrical source. These can't be fitted with a set-back thermostat. Turn off the electrical supply to your furnace and turn up the thermostat. If the furnace burner comes on, you have a millivolt system and you shouldn't buy a set-back thermostat. This is intended as a quick test — do not leave the furnace running without the electrical supply.

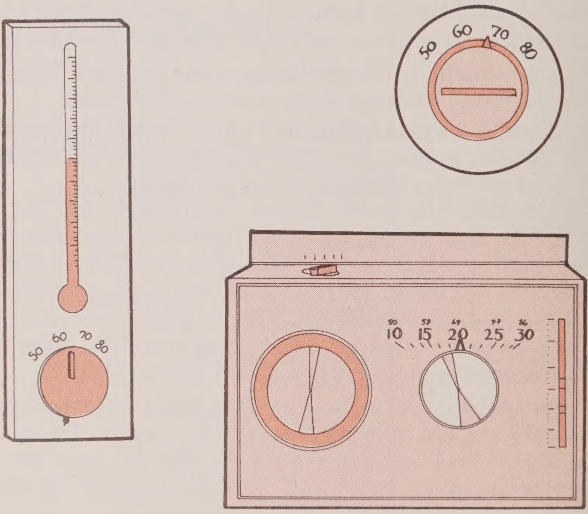
The Coldest Days May Be A Problem

On the very coldest days a properly sized furnace should be running almost constantly. Because most heating systems are oversized there is more than enough capacity to boost temperatures back to normal after each setback. However, for systems that have been downsized, it may not be practical during the coldest periods of the winter to set back the thermostat more than 6°C (10°F).

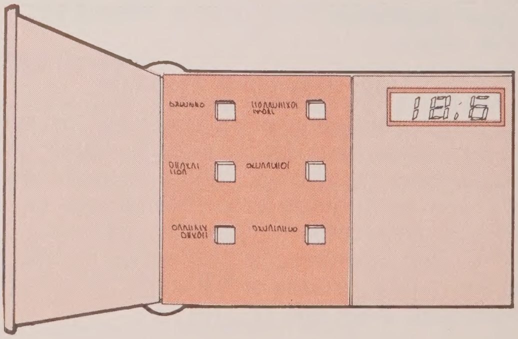
Some areas in the house can become too cold due to large set-backs in temperature. The result can be discomfort, surface condensation, or freezing pipes. The problem is often an unbalanced system. The solution is not to reduce the amount of temperature set-back but to improve the supply of heat to the cold area as described in the next section, or to reduce the need for heat by insulating and sealing air leaks.

Thermostat Location

If you are replacing your existing thermostat, you may want to relocate it. Your thermostat should be located where it will respond to the actual heating needs of the home: it should be installed on an inside partition wall, away from radiators, warm air registers, direct sunlight, doorways to outside, refrigerators, stoves, lamps and stairwells.



THERMOSTATS



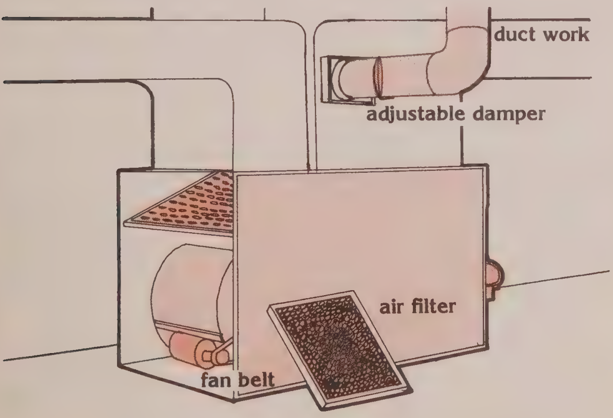
Get The Heat Where It's Needed

Most homes are heated with a single furnace (or boiler) and the heat is distributed by ducts or pipes controlled by dampers or valves. Only some of the heat gets to where it's needed. Often a great deal of heat is lost in transit.

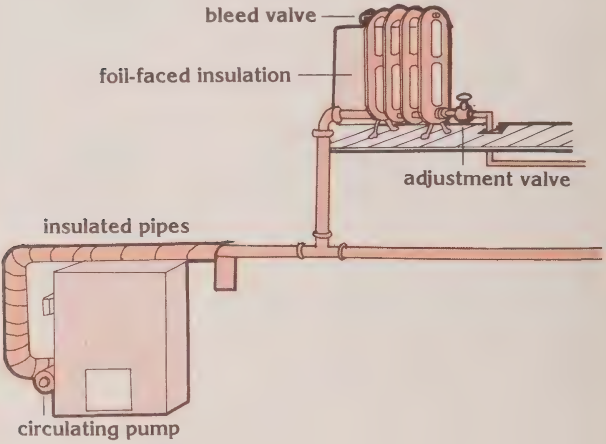
Heat loss through the distribution system can be particularly high in basements. In many cases this is the warmest room in the house. When heat does not get to where you want it when you want it, the room is uncomfortable. It is a waste of energy to heat the entire house to 24°C just to keep one room at 20°C. Some projects for improving the heat distribution in your home are presented below.

Improvements To Forced-Air Heat Distribution System

- *Replace or clean furnace filters regularly* (once a month). Dirty filters restrict the flow of air.
- *Keep the furnace fan belt tightened properly.* A loose belt won't turn the fan. Allow about 25 millimetres (one inch) of play.
- *Balance the heating system* to distribute the heat to where you want it by adjusting the manual dampers which are usually found in the air ducts in the basement. The floor registers in each room can also be adjusted until all parts of the house are sufficiently heated.
- *Seal the joints in the ductwork* and close off unneeded registers. The furnace fan can't get heat to a distant bedroom if it is all being blown into the basement. Most ductwork is very leaky until sealed with duct tape or silicone-type caulking. Clean the joints with a rag and solvent first (the leakiest spots are often dirty and oily) and use a good quality duct tape.



- *Insulate all ducts* longer than two metres (six feet). Insulate shorter lengths as well in areas that don't require temperatures above 10°C (50°F). If you purchase the appropriate insulation, insulating the ducts is an easier task. Use a roll of flexible foil-faced fibreglass duct wrap. Cheaper and more available are RSI 1.4 (R-8) fibreglass batts which can be wrapped around ducts with twine and covered with a polyethylene plastic.
- *Don't block the return air grill.*
- *Don't block registers with furniture or drapes.* Curved deflectors can be purchased at hardware stores and placed over registers to direct air flow into the room rather than over the cold windows (unless condensation is a problem). Caulking and weatherstripping the window will eliminate uncomfortable drafts.
- *A two-speed furnace fan* can even out large differences in temperature from room to room. It will also extract more heat from the heat exchanger. Ideally it should be used with a flue damper (see page 17).



Improvements To Hot Water Heat Distribution Systems

- Some old systems use gravity to circulate the hot water. If this is your situation, you can install a circulating pump. Circulating pumps are expensive ($300 to $350) but the potential fuel savings are as high as 30 per cent. The pump should have valves on both sides to permit removal without draining the whole system. Some older systems may require a furnace bypass to increase the flow of water. Discuss this with your installer.

- If you have an aquastat (a water temperature control) on your boiler, consider reducing the minimum temperature to around 49°C (120°F) during the warmer parts of the heating season. All you require is a screwdriver; *have your service mechanic show you how to adjust it.* A lower temperature will reduce overheating in the spring and fall. You shouldn't do this if you have a stainless steel boiler or if your main boiler also heats your domestic hot water. Another more expensive option is to install a modulating aquastat to reduce temperatures automatically as outdoor temperatures rise.
- *Wrap exposed and accessible heating pipes* with insulation. Special, expensive insulation is available.You can also use strips of 25 millimetre (one inch) flexible foil-faced fibreglass that can be tightly wrapped around one or more pipes and taped or stapled together. Keep insulation one metre away from the flue and high temperature areas of the portals and doors on the boiler.
- *Insulate behind radiators.* Glue foil or foilfaced rigid insulating board to the exterior walls behind hot water radiators. The thickness of the board should be less than the available space to provide an air space between the the rad and insulation. Cut the board slightly smaller than the radiator and tape the edges with foil tape. This application is especially useful for masonry houses where the walls aren't insulated.
- *Keep radiators well vented and unobstructed* to enable heat to get into the room. Clean the coils if necessary.
- *Bleed air from the radiators* as needed. To bleed air, open the valve. It will sputter until the air pockets are removed. When you have a steady stream of water, close the valve.
- *Install thermostatically controlled valves* on two-pipe system hot water radiators. On a two pipe system, each radiator can be controlled separately. These can be operated on a room by room basis and will shut off the heat to the radiator when the room reaches a pre-set temperature. Valves are especially cost-effective in rooms that tend to overheat during portions of the day. Try to co-ordinate their installation (which can be costly) with the replacement of the boiler or other repairs.

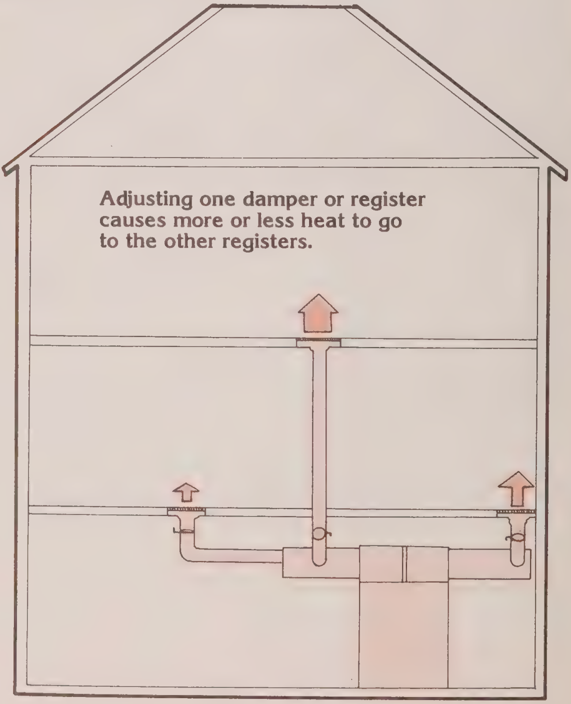
Special Distribution Problems

Your house may have a room that is either too cold or too hot. Identify the branch duct which feeds the problem room. Then locate the point where it leaves the main trunk duct (the plenum). Reposition it into a more efficient position on top of the air plenum if possible. Another option is to have a booster fan installed in that duct.

Often the room can be made more comfortable by caulking and weatherstripping or by adding extra glazing or window insulation.

If the problem is severe, an effective but expensive option is to have the system divided to provide an additional heating zone for the problem area. The new zone can be kept significantly cooler or warmer than the rest of the house to suit your living patterns. For a hot water system, this involves installation of an additional circulation pump or zone valve, a warm air system requires a motorized damper. To operate these controls, an additional thermostat is required, preferably a programmable type.

If problems with heat distribution persist, or if your building is large and difficult to control, it is worthwhile to contact a heating system specialist. One solution may be to install a baseboard electric heater in the cold area.



II. MAJOR ALTERATIONS

Wait, Upgrade or Replace?

If you are planning major alterations to your heating system, you have to decide how to proceed, when to proceed and how far to go. This is a complicated decision and you should get at least two or three opinions from registered heating contractors before making your choice.

If you are currently heating with gas or electricity, there are few major modifications you can make that are worthwhile in the short term.

If you heat with oil, you must decide whether to wait, upgrade your existing system or convert to another fuel source.

Conversions from oil to alternate systems, (including mixed systems if they reduce oil consumption by 50 per cent) are eligible for the up to $800 Canada Oil Substitution Program (COSP) grant (see page 26 for details). With this grant, major modifications will pay for themselves within a relatively short time.

When You Should Wait

Waiting is often the best policy, especially if your heating system is still in good shape.

If possible, you should weatherize and insulate your home before buying a new heating unit. Your home will be more comfortable in both winter and summer. This will also allow you to buy and maintain a smaller, less expensive heating system.

If energy conservation measures are taken *after* buying a new furnace, the furnace will be oversized. This leads to frequent and wasteful on and off cycles.

There are many new efficient furnaces being introduced to the market and costs are coming down. Waiting may give you more options to choose from.

When You Should Upgrade

In certain circumstances, oil furnaces can be upgraded as an interim strategy. Upgrading can involve changing fuel nozzles, adding retention head burners and a new solenoid valve (see page 16).

If you have an oil system less than 10 years old, have it inspected by a knowledgeable specialist to be sure the system doesn't have any major deficiencies. If the system is still in good shape, you have the options of upgrading the burner, adding an electric plenum heater or, if technically feasible, converting the furnace to run on natural gas (see page 19).

When You Should Replace

If your oil or gas system is in poor shape or your furnace is over 15 years old, it should be inspected because it is probably not worth upgrading. Wait until you have weatherized and insulated your home; then replace the furnace with a new unit properly sized for your reduced needs and, if possible, one which runs on an energy source other than oil.

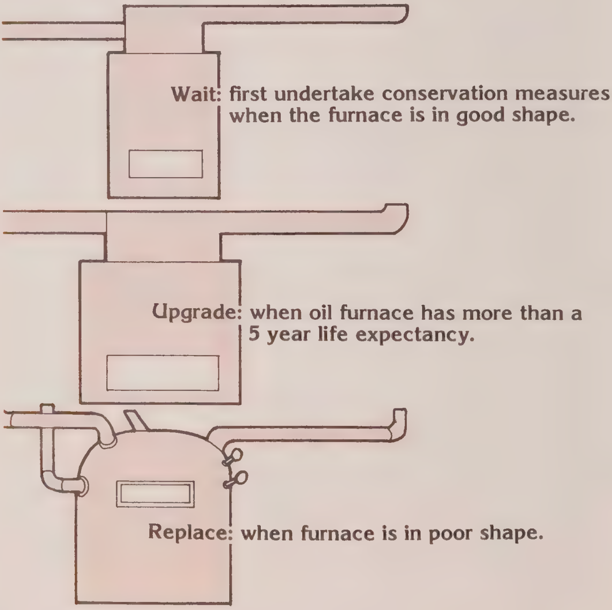
If your system has broken down and can't be repaired easily, you'll have to consider replacement. If your system is now on its last legs, the choice is more difficult. *Replacement may be the only way to ensure your choice is made in the offheating season.* This provides time to shop around and choose the most appropriate system.

There are many systems available. The section starting on page 18 discusses some of the choices.

How Much Efficiency?

As a general principle, the more you pay, the more efficiency you get. But at some point, the return in reduced fuel bills might not justify the added expense. A super-efficient furnace, for example, can reduce your fuel bill by 30 to 40 per cent. If your fuel bill is high, say $2000, it will pay for itself quite quickly. However, if your fuel bill is low, say $600, then it will take far longer to pay for itself.

The chart at the back of the booklet is drawn from one study comparing the costs and savings of different systems.



Upgrading Existing Oil Systems

In Ontario, the cost of upgrading oil systems is not covered by the Canada Oil Substitution Program (COSP) grant. Even so, upgrading can make sense if you have a reasonably new system and if natural gas will not be available within the next few years. Upgrading becomes more economical when you combine it with energy conservation measures to further reduce your fuel requirements. The upgrading options are discussed below. Your service mechanic will assist you in choosing the most suitable approach for your circumstances.

Downsizing

Because most furnaces installed in Canada are capable of producing much more heat than the building can use, they rarely get a chance to run long enough to reach their optimum efficiency.

Many furnaces actually spend most of their time not running at all. When the furnace sits idle for long periods, warm indoor air and heat from the furnace is lost up the chimney, creating heat losses.

Downsizing oil furnaces means reducing the firing rate or essentially changing the burner nozzle for a smaller size. Downsizing can reduce fuel bills by seven to ten per cent. The more excess capacity your furnace has, the more fuel you save by downsizing. The costs will be negligible if the service mechanic does it during a regular service call, or at the same time as other upgrading measures. In any event, nozzles tend to collect deposits and should be replaced regularly. The rate of deposit build-up can be reduced by having your service mechanic install a 5 micron filter.

There Are Limits To How Far Down You Can Go

Ideally, you would want to downsize the furnace so that during the coldest days of the year the furnace is running almost constantly. However, in practice your service mechanic will have to check the condition and efficiency of the furnace to determine what amount of downsizing is possible.

For example, if the temperature of the flue gases in your chimney is already lower than 180°C (350°F), it is not possible to downsize without risking chimney condensation. In some cases, the furnace may specify a nozzle size and it is not possible to go more than two sizes lower without creating air mixing problems unless you also install a retention head burner. For many houses, there simply isn't a nozzle size small enough to match the heat requirements of the building. The smallest nozzle is 0.5 gallons per hour, or about 70,000 BTUH output.

Retention Head Burners

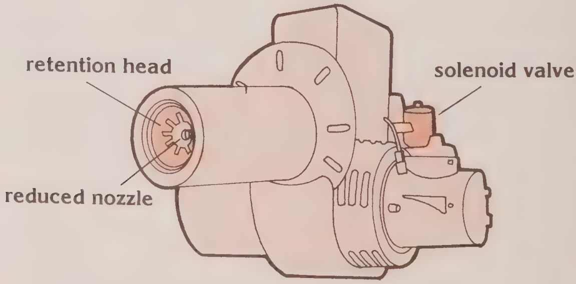
A retention head burner mixes the air and oil spray in a vigorous turbulent action. This allows the retention head burner to achieve combustion of the oil with considerably less excess air. Less air entering the burner means less heat escaping up the chimney.

You may improve your existing oil burner with a new, high efficiency retention head unit. Your fuel savings may be as high as 10 to 25 per cent. Before tackling the job, however, the furnace mechanic must determine whether the job is feasible. Do not proceed if:

- The furnace is over 15 years old. (Boiler systems can have a longer life, however.)
- The heat exchangers are not able to withstand the higher temperatures of a retention head burner. (Downsizing the nozzle may eliminate this problem).
- The furnace already has a retention head burner.
- The furnace operates at over 77 per cent peak efficiency after cleaning and tuning.

Many existing burners may be fitted with a *retention head kit* approved by the Canadian Standards Association (CSA). The cost is low and it gives the same performance as a new burner.

For furnaces with burners in poor condition, or for which retention head kits are unavailable, you can purchase complete new retention head burners. If you have to replace the older furnace with a new oil furnace, you can still retain this newer burner. All furnace combustion chambers must be fitted with a ceramic fibre lining to withstand the higher flame temperatures.



OIL BURNER

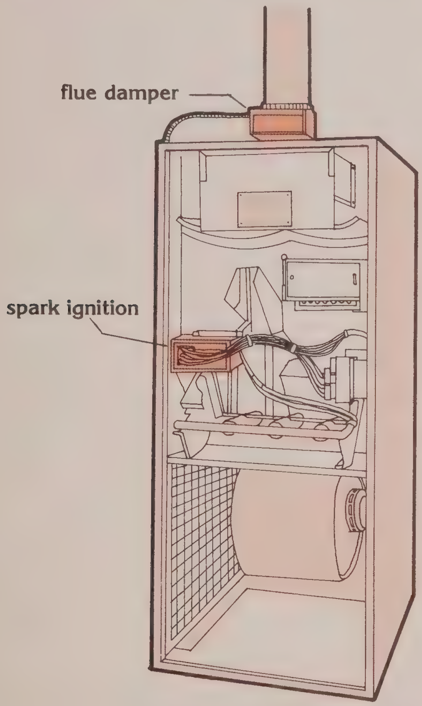
Solenoid Valves

A delayed action solenoid valve can also be installed for even higher efficiencies. The valve controls the flow of oil to prevent smoky starts and stops. Delayed action valves are always a good idea for oil systems that are being upgraded.

Flue Dampers

A flue damper is a device which stops the flow of air up the chimney when the furnace is off. It is installed in the vent pipe between the barometric damper and the chimney base. It can be installed by a certified burner mechanic for about $350 (Spring 1983). Savings range from three to seven per cent and do not usually justify the high cost. Moreover, a properly sized furnace with a retention head burner will keep chimney losses at a minimum. Flue dampers are, however, an excellent feature on new furnaces.

In Ontario, flue dampers cannot be added to existing gas systems.



New gas furnace with integrated spark ignition and flue damper.

Flue dampers are available for new or existing oil furnaces.

Replacement Options

Going "off oil" allows several options, including wood, solar or propane. However, the two most common choices are natural gas and electricity.

The National Energy Program has established the *wholesale* price of natural gas at 65 per cent of oil for the same amount of heat content. This policy is law until 1986 and the federal government is committed to maintain the competitive advantage of gas over oil well beyond that time. Ontario retail prices will reflect these prices quite closely. In 1982, for example, the retail price of gas was approximately 66 per cent that of oil.

The relationship between electricity prices and oil and gas for the same heat content is not fixed in a similar way. In Toronto, the 1982 retail price of electricity (at 100 per cent efficiency) was approximately 14 per cent less expensive than oil and 33 per cent more expensive than natural gas (oil and gas at 65 per cent efficiency).

Taking *only the cost of fuel into account,* gas is expected to retain its competitive advantage for the next several years. Prices are subject to many factors, however, and you should check the situation at the time you make your decision. Because your new system will have a life expectancy in excess of 15 years, you must consider the long term as well as the short.

In many parts of Ontario, wood is another attractive option, particularly if you have access to wood at below market rates and have storage capacity. For maximum convenience, you can combine wood with oil or electric heating as a combination central furnace, or you can place a separate space heating wood stove in your main living area.

If you are choosing an alternate fuel, there are a variety of other factors you should consider.

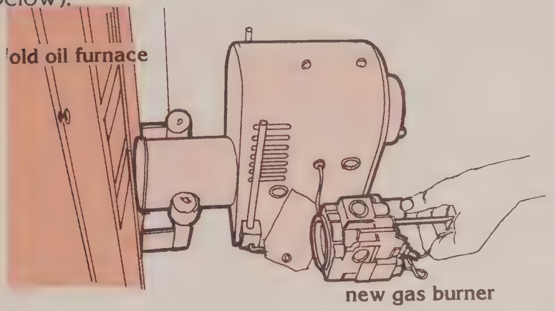
- Major energy conservation work in your house can substantially reduce your heating requirements to the point where most conventional systems will be oversized.
- Hybrid systems, such as electric plenum heaters with oil furnaces, can be used.
- A heat pump, though more expensive than most heating systems, will also provide air conditioning.

Additional details to consider are presented throughout this booklet. These include the requirement for a new chimney liner if you switch to gas, or the possibility of an increased service entrance of 200 amperes instead of 100 if you switch to electricity.

Natural Gas Systems

In gas conversion, the gas service is connected and the oil tank is removed. In 1983, you will probably also require a new chimney liner. This reduces the corrosion caused by condensation in the chimney. The new system will most likely be one of the four types listed below:

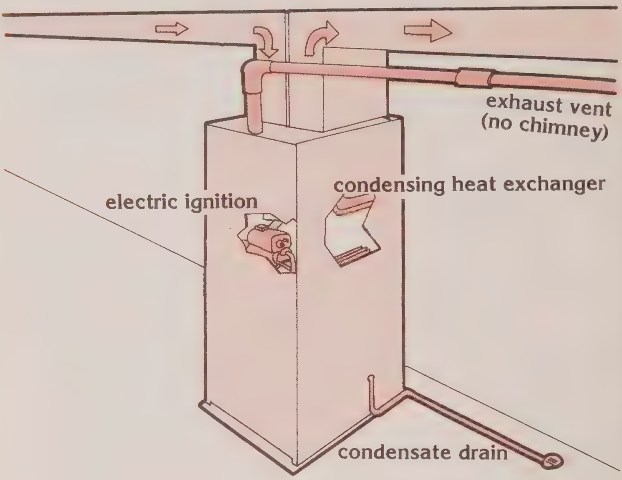
1. *Gas Conversion Burner*
   A gas conversion burner can often replace the burner component of an oil furnace. You can do this if your oil furnace is designed for conversion and is in good condition. The cost of converting an existing furnace is relatively low. There is little, if any, increase in the efficiency of the system. However, fuel costs can be expected to drop by an amount equivalent to the price difference between oil and gas, currently about 35 per cent. For highest efficiency, you should request a gas burner with electronic ignition (see description below).



2. *Conventional Gas Furnace or Boiler*
   If your oil furnace or boiler is old, it can be replaced with a new gas unit. The expected savings are equivalent to the price difference between oil and gas, approximately 35 per cent.
3. *Conventional Gas Furnace with Energy Saving Features*
   Forced air systems can achieve an additional efficiency of approximately 10 per cent by incorporating a certified gas furnace with an *electronic ignition* and an *automatic vent damper.* The electronic ignition reduces fuel consumption by eliminating the need for a continuously burning pilot light. The automatic vent damper shuts off the chimney when the furnace is not operating and reduces warm air losses. This kind of furnace is less effective when it is operated in conjunction with a gas hot water heater. Chimney losses increase because the damper has to be open for the hot water tank.

4. *Super-Efficient Gas Furnaces and Boilers*
   You can purchase more costly gas furnaces and boilers that operate without a chimney and achieve peak efficiencies as high as 95 per cent. These units are usually called *condensing furnaces or boilers.* Because there is very little heat left in the combustion gases, the water vapour condenses and drains to a floor drain. The remaining gases are vented by plastic piping through the walls to the outdoors.

CONDENSING GAS FURNACE



There is also another type of gas furnace being introduced which has no chimney. It uses a special "induced" exhaust, but it does not have the extra condensing heat exchanger. This furnace has a peak efficiency of about 85 per cent and is currently cheaper than condensing furnaces.

The additional investment for these systems is particularly worthwhile if you have a high fuel bill, since the savings will pay for the increased investment in a short time.

Propane Heating as a Stop-Gap
If your furnace or boiler has to be replaced and natural gas is not yet available, you could consider using propane in the interim. Most natural gas units without an electronic ignition or with an induced draft fan can run on propane with a minor modification. Propane is delivered by truck like fuel oil. Because of the higher cost of propane immediate savings over oil can be realized only if the unit is a super-efficient type.

Electric Heating Systems

A large portion of the cost of converting to electric heat is the approximately $1000 charge (Spring 1983) to upgrade the service entrance to a 200 amp service. If you have the required service, the electric heating option becomes much more cost effective.

Electric resistance heaters should reduce heating costs from a typical oil system. The house will also become more air-tight if you can eliminate the chimney. This will save additional energy and possibly raise indoor relative humidity levels. For more details see the ministry's fact sheet, *Fresh Air and Humidity in a Tighter House.*

Electric Furnaces or Boilers

You can entirely replace your existing oil furnace or boiler with a central heating system using an electric furnace or boiler. Your heat distribution system is retained and must be cleaned and lubricated regularly as before. Otherwise the maintenance costs are minimal.

Electric Baseboard Heating

Electric baseboard heaters have virtually no maintenance costs. Each room has its own thermostat which allows you to maintain lower temperatures in rooms not being used (zoning), which could lower heating costs further. The installation costs vary considerably (multi-storey houses are the most expensive), but costs may be higher than an electric furnace.

You may consider installing wall-mounted thermostats rather than baseboard units to permit accurate temperature set backs. However, this will be more expensive, especially if an automatic set-back thermostat is installed in each room.

Heat Pumps

A heat pump is an electrically operated heating and cooling system that extracts heat from the outdoor air, water or ground and discharges it into the furnace ducts. Air systems can heat the home until the outside temperature drops to a point where the back-up system is needed (oil, gas or electric). In the summer, the heat pump can be reversed to provide cooling by removing heat from indoor air and expelling it outdoors.

The high capital investment in a heat pump system can usually be justified only if you feel the need for summer air conditioning and you are willing to pay the extra cost. Many homes can be made comfortable in the summer by weatherizing, insulating, using drapes and blinds effectively and insulating attics.

Supplementary Systems

Wood Heating Systems

Wood heating systems are most appropriate for homeowners with access to wood at reasonable prices. Two systems are available: free standing, air-tight wood stoves, and wood furnaces which are connected to conventional heat distribution ducts or pipes.

There is a wide selection of combustion furnaces certified by the CSA that automatically switch from wood to oil or electricity (but not natural gas or propane). These combined systems are very convenient, but may not be worth the investment if you already have a serviceable furnace to use as a back-up. In this case you should buy a separate air-tight wood stove. If you are keeping an oil furnace only as a back-up for wood, retention heads or other expensive upgrading measures are probably not needed because of the low oil bills.

Before deciding upon a major investment in wood heating, be sure that you are prepared for the extra time, effort and maintenance that is required. You will also need storage space for the wood. Compared to other systems, wood has a higher risk of fire or smoke problems.

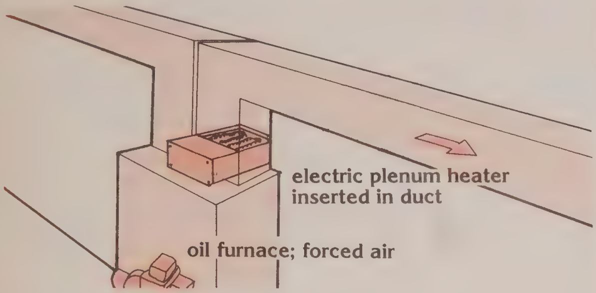
For safe operation, wood heating systems must be correctly installed, use a suitable chimney, and be maintained regularly. Air-tight wood stoves and furnaces approved by the Canadian Standards Association or Underwriters Laboratory of Canada and which can reduce oil consumption by over 50 per cent are eligible for a Canada Oil Substitution Program (COSP) grant.

When you install a wood furnace (either combination fuel or add-on) ensure that the ductwork is modified to meet safety guidelines as outlined in Canada Mortgage and Housing Corporation's booklet, *Heating With Wood Safely. Always obtain a building permit and have the installation inspected by a qualified official* (check with your fire department). Notify your insurance company to determine whether the installation will affect your policy.

Electric Plenum Heaters

The electric plenum heater is an electric heating unit installed in the warm air plenum of an oil furnace. It utilizes the existing furnace blower and ductwork to distribute the heat it produces. Most units are equipped with *load controllers* and an automatic fuel selection switch. These units are preferable because they enable the home to be heated electrically for much of the heating season.

The oil furnace takes over in the colder weather. A plenum heater is less expensive to install than an all electric system because it doesn't require electrical service upgrading. The controls on most plenum heaters automatically prevent the unit from drawing more power than is available. Your heating contractor or utility can tell you if a plenum heater is compatible with your existing system and eligible for a COSP grant.



Spot Heating

Portable space heaters can be used to great advantage by maintaining comfort in one room while the rest of the building is kept at a much lower temperature.

Electric Heaters

Portable electric heaters approved by the Canadian Standards Association are safe to use, readily available, reasonably priced, maintenance free and use a fuel that is available in every home. Radiant models are more expensive, but are more effective because they can be used to supply heat more directly. Ask an electrician if you have enough excess electrical capacity and circuits for heaters.

Kerosene Heaters

The new models of portable kerosene heaters are safe to use provided that the kerosene is *stored safely* and *that the heater is used properly.* Crack open a window in closed spaces or an air-tight house. The units are not vented to the outside so if they get out of adjustment, harmful gas may build up. For this reason you should use these heaters in well ventilated spaces. Kerosene heaters are less convenient than electric heaters because they have to be refueled, their initial purchase price is higher and they cost at least 25 per cent more to operate. However the larger units can put out more heat if needed than electric heaters.

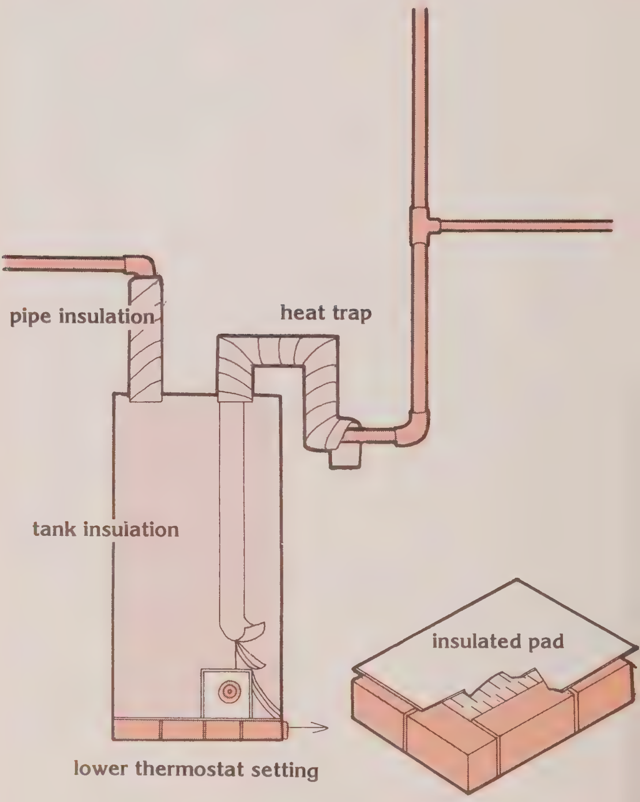
Domestic Hot Water

Hot water for washing and bathing is generally the highest energy cost in a home next to space heating. If you are thinking about alterations to your space heating system, this may be the best time to plan for more efficient water heating as well.

Choice of Fuel

If you have an electric hot water heater and are converting your home to gas, you may want to keep the electric hot water heater. Gas hot water heaters currently available in Ontario are not yet efficient and they lack such energy saving features as extra insulation, electronic ignition and flue dampers. However, depending on the current rate structure, gas may still be less expensive than electricity.

If you are installing a gas-fired hot water heater, consider renting the unit from your utility company. You then have the option of replacing the unit in the future when more energy-efficient units are on the market.



Installation

When installing a new hot water tank, you should keep in mind several energy conservation principles:

1. Locate the tank close to the most frequently used hot water taps, unless this will result in additional costs.
2. Have the plumber install a "heat trap" in the water lines (see illustration). The insulated inverted elbows prevent hot water from rising into the pipes and siphoning heat away from the tank.
3. Construct an insulated pad for electric hot water tanks to reduce heat loss into the basement floor. Use 50 mm (2 inches) of rigid foam insulation bordered with bricks and covered with protecting plywood.
4. Lower the water temperature in the tank by lowering the thermostat setting. Many homes can lower the thermostats to 49°C (120°F). This also reduces the danger of scalding. Dishwashers may require a higher setting of 60°C (140°F) unless they have a water preheater. Experiment until you discover the setting that meets your hot water needs. *Ensure that the power to electric heaters is off before removing the cover plates to adjust the thermostat.*
5. You can buy prefabricated insulation kits approved by the Fuel Safety Branch from building suppliers that increase the insulation on your existing tank. They should be installed in the recommended manner. *Do not insulate over the thermostat covers on electric water heaters or on the top or bottom of oil or gas heaters. The access and air pathways should not be blocked.* Contact your utility if this is unclear.
6. Reduce heat loss from the tank to the tap. If the pipes pass through unheated areas (a cool basement is still considered to be heated), or if the tap in question is used often and is at a considerable distance from the tank, it is usually cost effective to wrap the water pipes with strips of fibreglass and foil or a prefabricated pipe insulator.
7. Turn off the hot water tank whenever the house is unoccupied for long periods.
8. And finally, reduce your hot water consumption by using low-flow shower heads and faucet aerators.

III. FURTHER INFORMATION

Canada Oil Substitution Program (COSP)

This federal government program offers grants to homeowners and businesses substituting natural gas, electricity, propane, wood, wind, solar, coal or peat for oil as a means of heating.

The taxable grant covers 50 per cent of eligible conversion costs up to a maximum of $800 for single homes and higher for centrally heated residential multiple-unit buildings. Full information and application forms for gas and electric conversions are available from gas and electric utilities. For other conversions call the federal Conservation and Renewable Energy Office toll free 1-800-268-2207. In Toronto call 252-5866.

Residential Energy Advisory Program (REAP)

Under this program, Ontario Hydro and municipal utilities advise homeowners on ways to make the home more energy-efficient and will lend up to $2,000 at interest rates close to Hydro's borrowing rate (which is currently about 5% below market) to improve a home's energy efficiency (weatherizing and insulating), upgrade electrical wiring, and convert to electric heating.

This service is available to all Ontario Hydro's rural customers. Municipal electric utilities have the authority to undertake similar programs in their service areas, and many of them have decided to do so. Call Ontario Hydro at (416) 592-3815 or your municipal electric utility or public utilities commission.

Gas Utilities

Some gas utilities also offer conservation and conversion packages and can finance conversions with repayment on the monthly gas bill. Contact your local utility.

Canadian Home Insulation Program Update (CHIP)

Energy, Mines and Resources Canada has announced a revision to the Canadian Home Insulation Plan (CHIP). Effective November 15, 1982, the maximum taxable grant of up to $500 will be calculated on 60 per cent of the combined costs of materials and labour on homes built before 1971. Remember that energy conservation should precede furnace conversion, if possible. Contact CHIP by calling 1-800-268-1818. In Toronto call 789-0581. In area code 807 call collect to 416-789-0581.

Ontario Ministry of Energy

The Ontario government has produced a publication on fuel conversions called *Weighing the Oil Drop Decision.* This publication provides a detailed economic analysis of the various options for householders, and is available from the Ministry of Energy. Call Zenith 8-0420 outside Toronto and ask for 965-0863. In Toronto call 965-0863.

Enersave Heatline

The federal government has a free telephone advisory service to answer technical questions relating to energy conservation. ENERSAVE also offers a free computerized home energy analysis that is mailed to householders who complete a questionnaire on their home. ENERSAVE distributes government publications such as *Keeping the Heat In* (a guide to home insulation), and *Switching to Wood*. Call 1-800-267-9563. In Ottawa call 995-1801.

Ontario Home Renewal Program/ Residential Rehabilitation Assistance Program (OHRP/RRAP)

These programs provide grants and loans to low income families for home improvements. Heating system modifications, weatherization and insulation are allowable items. Check with your local municipality or the Canada Mortgage and Housing Corporation local office for further details.

When Hiring An Installer

Prices and quality of workmanship can vary widely. Try to get at least three quotes before proceeding and make sure that the quotes are carefully itemized to ensure that they can be compared. Ask for references from previous customers and check with your local Better Business Bureau to ensure that the contractor is reputable and handles complaints properly. *Ensure that gas and electrical installations are inspected by the appropriate utility before making your final payment to the contractor.* You may also require a building or heating permit. Oil installations are usually inspected by officials of municipal building departments as part of the building permit or heating permit process. Remember, if you plan to apply for the COSP grant, the invoice *must be properly itemized and accompanied by a receipt from the contractor.*

Comparative Cost Analysis

The following chart is based on information that was prepared from December 1982 to February 1983 for the Toronto area. It is included here to illustrate the process of comparing options over the long term and short term.

Because such information becomes dated very quickly you should *not use it to make your decision.* Studying this chart will, however underline the importance of the various factors you should consider.

Column B, installation costs, assumes you take advantage of a COSP grant (which is taxed at 30 per cent).

Column C shows the first year savings compared to oil.

Column D is a calculation commonly used by financial analysts. It considers all the expected costs over a 15-year period for each alternative. This includes installation, maintenance, fuel prices as projected in February 1983 and borrowing costs. The calculations are based on a house which would require 3000 litres of oil to heat. The costs will be different for different heat loads.

Don't forget the other common sense factors not reflected in this chart. For example, high efficiency will not be so important if you have already reduced your fuel bill substantially through energy conservation. Or, if you have a good operational oil system you may wish to upgrade it and undertake energy conservation while waiting for newer and perhaps better, alternatives to be developed.

Further information is available in the Ontario Ministry of Energy's booklet *Weighing the Oil Drop Decision* from which these figures are taken. It is expected to be updated annually.

COMPARATIVE COST ANALYSIS
(Forced air systems)

	A	B	C	D
Heating System Replacement Options	Seasonal Efficiency	Approx. Installation Costs (Jan. '82)	% Cost Reduction From Oil	Discounted Life Cycle Cost (15 Years)
•stay with oil	65%	—	—	$14,400
•add plenum heater (no service upgrade)	86%	$800	13%	$12,400
•install gas burner (and chimney liner)	63%	$571	29.5%	$10,400
•install standard gas furnace (and chimney liner)	60%	$914	26%	$11,300
•install gas furnace — electronic ignition — flue damper (and chimney liner)	75%	$1,369	40.8%	$9,800
•install super-efficient gas furnace	90%	$2,444	50.7%	$9,600
•all-electric furnace with service upgrade	100%	$1,744	16.3%	$11,600
•all-electric heat pump-furnace with service upgrade	165%	$4,444	49.3%	$12,100

For Further Information

Renovation and Energy Conservation Unit
Ministry of Municipal Affairs and Housing
Queen's Park,
Toronto
M7A 1N3

Booklets
First, Seal Your House
Conserve Energy When You Renovate
A Window Review

Fact Sheets
Fresh Air and Humidity in a Tighter House
Energy Checklist for Renovators
Improving Fireplace Efficiency
Caulking and Weatherstripping
Basement Insulation
Air-Vapour Barriers
Exterior Insulation
Flat Roofs and Cathedral Ceilings

Ontario
Renews

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